

CLAIMS

- 1 1. A heat pump system comprising: a heat generator; a heat engine supplied
2 with heat engine working fluid by said heat generator having a heat engine
3 cylinder chamber, a heat engine piston, and a heat engine piston rod; a
4 preheating chamber employing said heat engine working fluid to heat said
5 heat engine cylinder chamber; a condensate pump supplying said heat
6 generator with said heat engine working fluid; a compressor driven by said
7 heat engine employing compressor working fluid having a compressor
8 cylinder chamber, a compressor piston, and a compressor piston rod; a
9 spacer separating and joining said heat engine piston rod and said
10 compressor piston rod; a sealing assembly associated with said spacer
11 separating said heat engine working fluid and said compressor working
12 fluid; and a valve assembly communicating with said heat engine cylinder
13 chamber and controlling the ingress and egress of heat engine working
14 fluid to said heat engine.
- 1 2. A heat pump system according to claim 1 further comprising, a turbo
2 booster for improving the efficiency of the heat engine.
- 1 3. A heat pump system according to claim 2, wherein said turbo booster is
2 powered by heat engine exhaust and operates to reduce back pressure on
3 said heat engine piston.
- 1 4. A heat pump system according to claim 1, wherein said preheating
2 chamber is an annular chamber surrounding said heat engine cylinder
3 chamber.
- 1 5. A heat pump system according to claim 1, wherein said sealing assembly
2 includes a pair of rolling diaphragms with a pressurized fluid interposed
3 therebetween.

- 1 6. A heat pump system according to claim 5, wherein said pressurized fluid
2 is water.
- 1 7. A heat pump system according to claim 1, wherein said heat engine
2 cylinder chamber and said compressor cylinder chamber are constructed
3 of a ceramic material.
- 1 8. A heat pump system according to claim 1, wherein said condensate pump
2 transfers said heat engine working fluid from a condenser to said heat
3 generator.
- 1 9. A heat pump system according to claim 8, wherein said condensate pump
2 has a housing with a cylindrical cavity for receiving a pump piston
3 attached via a driven shaft to said heat engine piston, and input and
4 output lines communicating with a pumping chamber formed in a lower
5 portion of said cylindrical cavity.
- 1 10. A heat pump system according to claim 9, wherein said condensate pump
2 is driven by said heat engine inducing said pump piston to reciprocate
3 within said cylindrical cavity and transfer said heat engine working fluid
4 between said condenser and said heat generator via said pumping
5 chamber.
- 1 11. A heat pump system according to claim 8, wherein said condensate pump
2 has a cooling chamber, and a cooling fluid is draw into and of out said
3 cooling chamber as said pump piston reciprocates within said cylindrical
4 cavity.

- 1 12. A heat pump system according to claim 11, wherein said cooling chamber
2 is formed by an upper portion of said cylindrical cavity, said driven shaft,
3 an upper surface of said pump piston, and a ceramic seal provided in said
4 upper portion of said cylindrical cavity and sized to sealingly interface with
5 said driven shaft.
- 1 13. A heat pump system according to claim 1 further comprising, a heat
2 exchanger for receiving heat from said heat pump system.
- 1 14. A heat pump system according to claim 13, wherein said heat exchanger
2 receives said compressor working fluid.
- 1 15. A heat pump system according to claim 13, wherein said heat exchanger
2 is a triple-tube heat exchanger receiving said compressor working fluid,
3 said heat engine working fluid, and a fluid to be heated.
- 1 16. A heat pump system according to claim 15, wherein said fluid to be heated
2 is selectively water from at least one of a water heater and a swimming
3 pool.
- 1 17. A heat pump system comprising, a heat generator for heating a working
2 fluid, a heat engine having a housing, a cylinder wall within said housing,
3 a preheating chamber between said housing and said cylinder wall, and a
4 line interconnecting said heat generator and said preheating chamber,
5 whereby working fluid supplied to said preheating chamber by said heat
6 generator heats said cylinder wall prior to the commencement of operation
7 of said heat engine.
- 1 18. A heat pump system according to claim 17, wherein said preheating
2 chamber is an annular space between said housing and said cylinder wall.

- 1 19. A heat pump system according to claim 17, wherein said cylinder wall
2 houses a piston and is made of a heat conducting ceramic material,
3 whereby heat in said cylinder wall is transmitted to said piston.
- 1 20. A heat pump system according to claim 17, wherein said housing is higher
2 than said heat generator, whereby any condensate formed by said working
3 fluid in said preheating chamber is returned to said heating chamber by
4 said line.
- 1 21. A heat pump system comprising: a heat engine operating on a heat engine
2 working fluid and having a heat engine cylinder chamber, a heat engine
3 piston, and a heat engine piston rod; a compressor operating on a
4 compressor working fluid and having a compressor cylinder chamber, a
5 compression piston, and a compressor piston rod; a spacer separating and
6 joining said heat engine piston rod and said compressor piston rod; and
7 a sealing assembly maintaining separation of said heat engine working
8 fluid and said compressor working fluid.
- 1 22. A heat pump system according to claim 21, wherein said sealing assembly
2 includes a pair of rolling diaphragms with a pressurized fluid interposed
3 therebetween.
- 1 23. A heat pump system according to claim 22, wherein said pressurized fluid
2 is selected to resist the migration of components of said working fluids
3 therebetween.
- 1 24. A heat pump system according to claim 22, wherein said pressurized fluid
2 is water.

1 25. A heat pump system according to claim 22, wherein said rolling
2 diaphragms have beads spaced by an annular insert having a fill tube for
3 controlling the presence and pressure of said pressurized fluid.

1 26. A heat pump system comprising, a heat engine having a heat engine
2 cylinder chamber and a heat engine piston movable therein, a turbo
3 booster powered by exhaust from the high pressure side of said heat
4 engine piston, a vacuum tank evacuated by said turbo booster, an engine
5 condenser, and a flow control valve connecting the low pressure side of
6 said heat engine piston to said vacuum tank during the power stroke of
7 said heat engine piston and connecting the low pressure side of said heat
8 engine to said condenser during the exhaust stroke of said heat engine
9 piston, whereby back pressure on said heat engine piston is reduced during
10 the power stroke thereof and equalized during the exhaust stroke thereof.

1 27. A heat pump system according to claim 26, wherein said turbo booster
2 includes a turbine wheel actuated by exhaust from the high pressure side
3 of said heat engine piston.

1 28. A heat pump system according to claim 27, wherein said turbo booster
2 includes a pump driven by said turbine wheel, said pump having an input
3 line connected to said vacuum tank and an output line connected to said
4 engine condenser, whereby a reduced pressure is maintained in said
5 vacuum tank.

1 29. A heat pump system according to claim 26, wherein said flow control valve
2 is actuated by a valve assembly controlling the ingress and egress of
3 working fluid to said heat engine cylinder chamber.

- 1 30. A condensate pump comprising: a housing with a cylindrical cavity; a
2 pump piston received within said cylindrical cavity; a driven shaft attached
3 to said pump piston; input and output lines communicating with a
4 pumping chamber formed in a lower portion of said cylindrical cavity; and
5 a cooling chamber formed by an upper portion of said cylindrical cavity,
6 said driven shaft, an upper surface of said pump piston, and a ceramic seal
7 provided in said upper portion of said cylindrical cavity and sized to
8 sealingly interface with said driven shaft.
- 1 31. A condensate pump according to 30, wherein said pump piston
2 reciprocates within said cylindrical cavity thereby transferring a working
3 fluid from a condenser through said pumping chamber to a heat generator.
- 1 32. A condensate pump according to 30, wherein a cooling fluid is drawn into
2 and out of said cooling chamber as said pump piston reciprocates within
3 said cylindrical cavity.
- 1 33. A heat pump system comprising: a heat generator; a heat engine having
2 a heat engine piston rod supplied with heat engine working fluid by said
3 heat generator; a compressor having a compressor piston rod driven by
4 said heat engine employing compressor working fluid; a spacer separating
5 and joining said heat engine piston rod and said compressor piston rod;
6 a sealing assembly associated with said spacer separating said heat engine
7 working fluid and said compressor working fluid; a heat exchanger
8 connected to a fluid reservoir whereby said heat engine working fluid and
9 said compressor working fluid are directed to said heat exchanger.
- 1 34. A heat pump system according to claim 33, wherein said fluid reservoir is
2 selectively at least one of a water heater and a swimming pool, and said
3 heat exchanger is a triple-tube heat exchanger receiving said heat engine

- 1 working fluid, said compressor working fluid, and a fluid from said fluid
- 2 reservoir.